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# EARTHQUAKES: Shaking in Texas makes officials worry about injection from drilling

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AZLE, Texas -- To Rochelle Clark, the earthquake sounded like a thud. She thought it was her sons horsing around in an upstairs bedroom at her home just off the main highway here.

Eva Garcia, who runs a beauty shop around the corner from Clark's home, said she saw framed photos shaking on the walls. One of her customers felt a chair move.

It seems most people in this small suburb have felt the ground shake at one time or another in the past few weeks. According to the U.S. Geological Survey, there have been 19 small earthquakes in the vicinity of Azle since Nov. 6, including a small one Tuesday. The strongest was a magnitude-3.6 quake Nov. 20.

"Unless you were laying in bed or sitting in an easy chair, you could feel it," said Leon Short, who has lived in the area for most of his 80 years.

There have been no injuries and no reports of property damage, but people here are beginning to get alarmed and are asking for answers, said Alan Brundrett, mayor of this bedroom community about 20 miles northwest of Fort Worth.

Brundrett and other elected officials have spoken to the Texas Railroad Commission, which oversees oil and gas development in the state, and hope the agency will investigate whether the quakes are related to the roughly six injection wells in the area that dispose of oil and gas drilling waste deep underground.

"If it is a man-made cause, my opinion is that man-made cause needs to stop," Brundrett said Tuesday.

So far, though, the investigation is off to a slow start. Railroad Commission inspectors have visited one of the wells in the area, said commission spokeswoman Gaye McElwain, and found that it is in compliance with agency rules. But agency rules don't address wells causing earthquakes.

USGS officials have been talking with researchers at Southern Methodist University about sending as many as four seismographs that SMU researchers could install near Azle. But it would be several days before they're in place.

"No one monitors earthquakes in the state of Texas," said Charlie Geren, a Republican state representative whose district includes Azle. Geren has spoken with researchers at the University of Texas and is sharing information with officials in Azle. But he said the responsibility for any further action lies with the Railroad Commission.

"When earthquakes are reported, our staff will determine if saltwater disposal wells are nearby and then inspect the facilities to ensure that they are in compliance with their Railroad Commission permit conditions," McElwain said. "Staff has not identified a significant correlation between faulting and injection practices."

## Getting to the cause

In other states, oil and gas agencies evaluating whether injection caused earthquakes have turned to organizations with more dedicated expertise in geology and quakes. The Ohio Department of Natural Resources in 2012 brought in scientists from the Lamont-Doherty Earth Observatory who linked injection to series of quakes in Youngstown (*Greenwire*, March 9, 2012). Oil and gas officials at the Oklahoma Corporation Commission have deferred to the state Geological Survey when looking at several quakes reported to be linked to oil and gas activities.

Seismologists say the first step in figuring out whether the earthquakes are man-made would be getting more accurate locations for the epicenters of the quakes. The closest monitoring instrument is about 60 miles away from Azle, so the locations being provided by USGS aren't very precise.

That distance has also caused more obvious problems. USGS on Tuesday had to revise its initial report that the most recent quake measured magnitude 3.4, when it determined that the quake was actually a much weaker 2.7.

The agency's map of earthquakes shows a shotgun pattern around the Azle area. With precise location information, the quakes would probably start lining up along underground faults, said Rob Williams, a research geophysicist in the Denver office of USGS.

"There may be some patterns we could detect," Williams said.

Texas already has had some of the best-documented seismic activity around injection wells. Researchers have linked injection to earthquakes in the Haynesville Shale in East Texas and the Barnett Shale in the Dallas area (*EnergyWire*, Aug. 7, 2012). Chesapeake Energy Corp. shut down two wells linked to quakes near the Dallas-Fort Worth Airport in 2009.

Another Chesapeake injection well near Cleburne was also voluntarily shut in after nearby earthquakes in 2009. On Tuesday, researchers at SMU released a study saying the series of earthquakes could have been caused by injection.

Researchers at the University of Texas have also linked small, barely felt earthquakes to oil extraction in the Eagle Ford in South Texas. And they found that underground injection of carbon dioxide to boost oil production "may have contributed to triggering" a series of earthquakes north of Snyder several years ago.

## What's shaking Azle?

The earthquakes here started small last month, with a magnitude-2.6 quake Nov. 6. They then rose in strength to a magnitude-3.6 on Nov. 20 and have been smaller since.

That's unusual for the area, said SMU seismology professor Brian Stump, who has studied earthquakes in North Texas for years.

"It's an area that hasn't historically had earthquakes," Stump said.

Williams of USGS said there are no active faults in the area.

Azle abuts a man-made reservoir, Eagle Mountain Lake, that supplies water to Fort Worth and other cities. A 2007 analysis found that the lake's 80-year-old earthen dam can withstand a magnitude-6 or -7 earthquake, said Louie Verreault, an engineer with the Tarrant Regional Water District, the organization that runs the lake. Instruments that measure ground movement and soil pressure show the dam hasn't been affected by the recent tremors.

The three active wells closest to Azle are run by EverVest Operating LLC of Houston; Bridgeport Tank Trucks in Bridgeport, Texas; and XTO Energy, an Exxon Mobil subsidiary based in Fort Worth, according to state records.

An XTO spokeswoman said its well had been operating for about four years with no trouble. The other companies didn't respond to calls seeking comment.

Scientists have known for decades that underground injection of fluid can lubricate faults and unleash earthquakes. Some seismologists now think the boom in shale drilling in the United States -- and the wastewater it produces -- might be causing a sharp increase in the number of earthquakes in the middle of the country.

Next door in Oklahoma, there has been surge of earthquakes since 2009. Oklahoma's 240 earthquakes of magnitude 3 or greater since then represent 10 percent of the earthquakes in the lower 48 states, second only to California (*EnergyWire*, Dec. 2).

Researchers and state officials have also linked such deep injection wells to earthquakes in Arkansas, Ohio and Colorado. More "earth-friendly" procedures, such as geothermal energy production and carbon sequestration, can also set the earth rumbling.

Oil and gas production is regulated almost entirely by states. But a federal law, the Safe Drinking Water Act, governs underground injection of drilling wastewater. U.S. EPA regulates disposal directly in a few states, such as Pennsylvania. But in Texas and most other drilling states, it has handed day-to-day regulation to the state.

The Safe Drinking Water Act doesn't make it illegal to cause an earthquake. Instead, EPA seeks to prevent earthquakes because they might harm the underground sources of drinking water that the act does protect.